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A DEEP-OCEAN ACOUSTIC POSITION KEEPER.(U)
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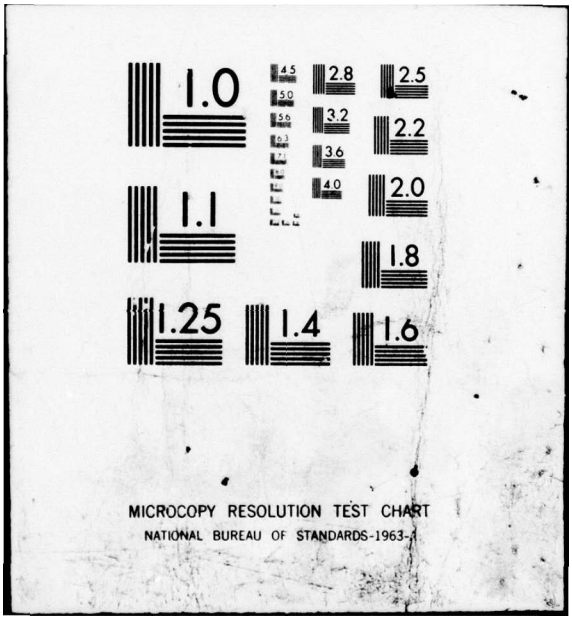
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MICROCOPY RESOLUTION TEST CHART
NATIONAL BUREAU OF STANDARDS-1963-A

(6) A DEEP-OCEAN ACOUSTIC POSITION KEEPER*†

by

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An acoustic transponder (see Fig. 1) has been developed for use at sea to enable oceanographic ships to maintain a given position in an area where navigational control is poor.

The system is comprised of a buoyant subsurface float containing the battery-operated transistorized electronics, .040-in. piano wire, and a simple anchor weight. The operating depth of the subsurface float is adjusted between 2000 and 4000 ft by the length of the piano wire.

The operation of this acoustic position keeper (APK) is as follows: The outgoing pulse from a fathometer is picked up by a hydrophone mounted on the float and processed by a narrow-band amplifier which keys a power oscillator, tuned to the fathometer frequency, driving a specially built ceramic transducer. Thus, for each outgoing fathometer ping, two echoes are recorded on the echogram: 1) a ping from the float and 2) the prolonged bottom reverberation. The slant range to the APK is read from the echogram, and the horizontal range is obtainable if the depth of the APK is known.

* Columbia University, Hudson Laboratories Memorandum-to-File No. 60, dated 15 December 1960.

† This work was supported by the Office of Naval Research.

A preliminary test of the system was run off Bermuda with the APK suspended 2000 ft deep from a surface float with an EDO AN/UQN - 1B fathometer as the interrogator. The float was for visual contact to correlate with the echogram as well as for retrieving the APK after the test.

The APK signal was recorded on the echo sounder and is readily apparent on the record (see Fig. 2) at 320 fathoms, well above the bottom echo. The beginning of the test is at the left of the figure and shows the lowering of the APK to 320 fathoms, where it leveled off. The record then shows the echo received as the ship approached the buoy at 6 knots and passed to the other side. What the record shows is essentially a "curve of maximum convexity," the 320-fathom apex being the point of the ship's overhead passage. The ship then steamed out of range of the transponder and turned back on a grazing angle indicated on the record by less rapid shoaling of the APK signal. The ship then approached at slow speed and drifted past the buoy. The end of the record shows the ping from the instrument as it was being hauled up.

It had been anticipated that the beamwidth of the Edo head would allow reception out to only 1325 ft. However, it became apparent from some of the data that horizontal ranges of 1810 ft were obtained. However, this range was only sporadically obtained, whereas the 1325 ft was consistently repeated. It seems safe to assume, then, that a 60-deg effective cone width is applicable to these computations. It is therefore possible to predict the horizontal range obtainable for various depths. For the convenience of other workers, such a table of curves has been drawn (see Fig. 3) which emphasize the fact that reception range is a function of transponder depth; if accurate positioning is wanted, the APK has to be shallow, but for large-range reception, it has to be deep.

A second test of the system was run with the float 2000 ft deep and anchored to the bottom with no surface link (see Fig. 4). From this it is apparent the ship had no difficulty in maintaining contact.

Future development of this type of APK will be in conjunction with a shipboard directional sonar. It is believed that this will eliminate the limited range problem and, in addition, will yield bearing information.

Fig. 1 Subsurface float with transistorized electronics pulled out for inspection. Float is 54 1/4 in. long and 8 5/8 in. o.d.

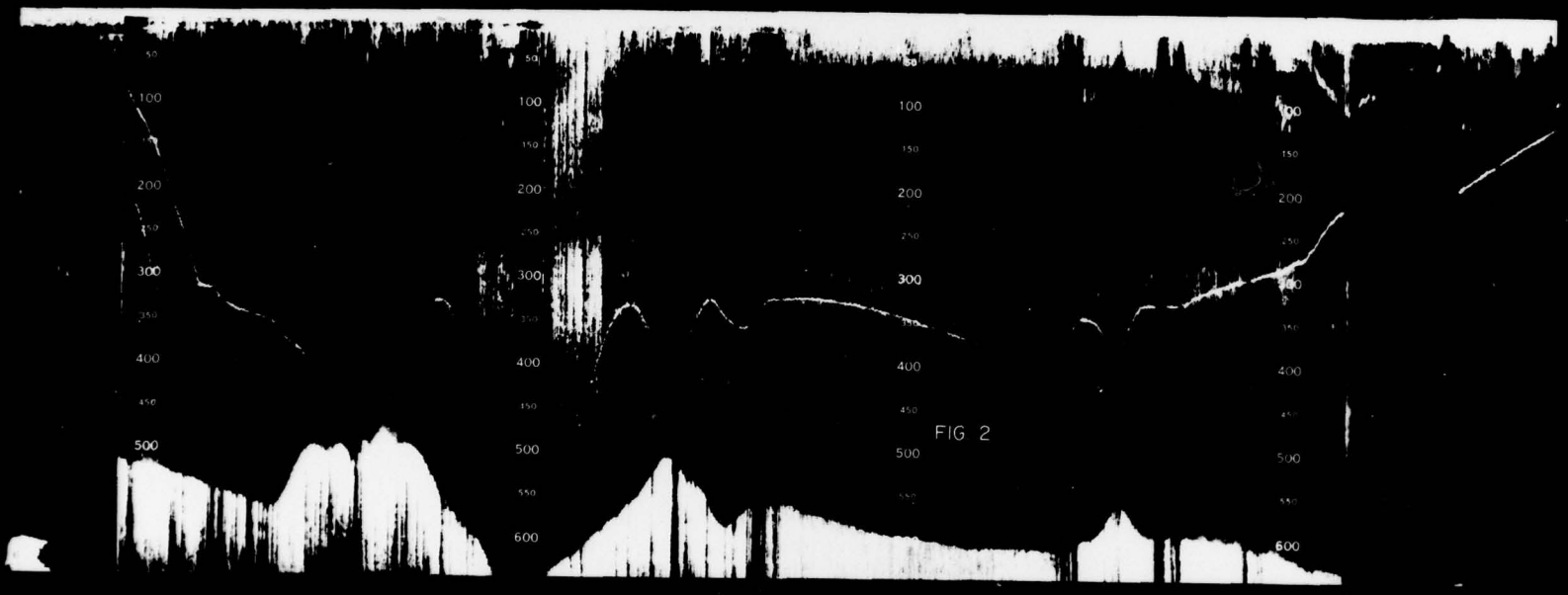

Fig. 2 Echo-sounding record. Scale is 0-600 fathoms. The short return at 320 fathoms is APK ping; the long return at 500 fathoms is the bottom echo.

FIG. 3

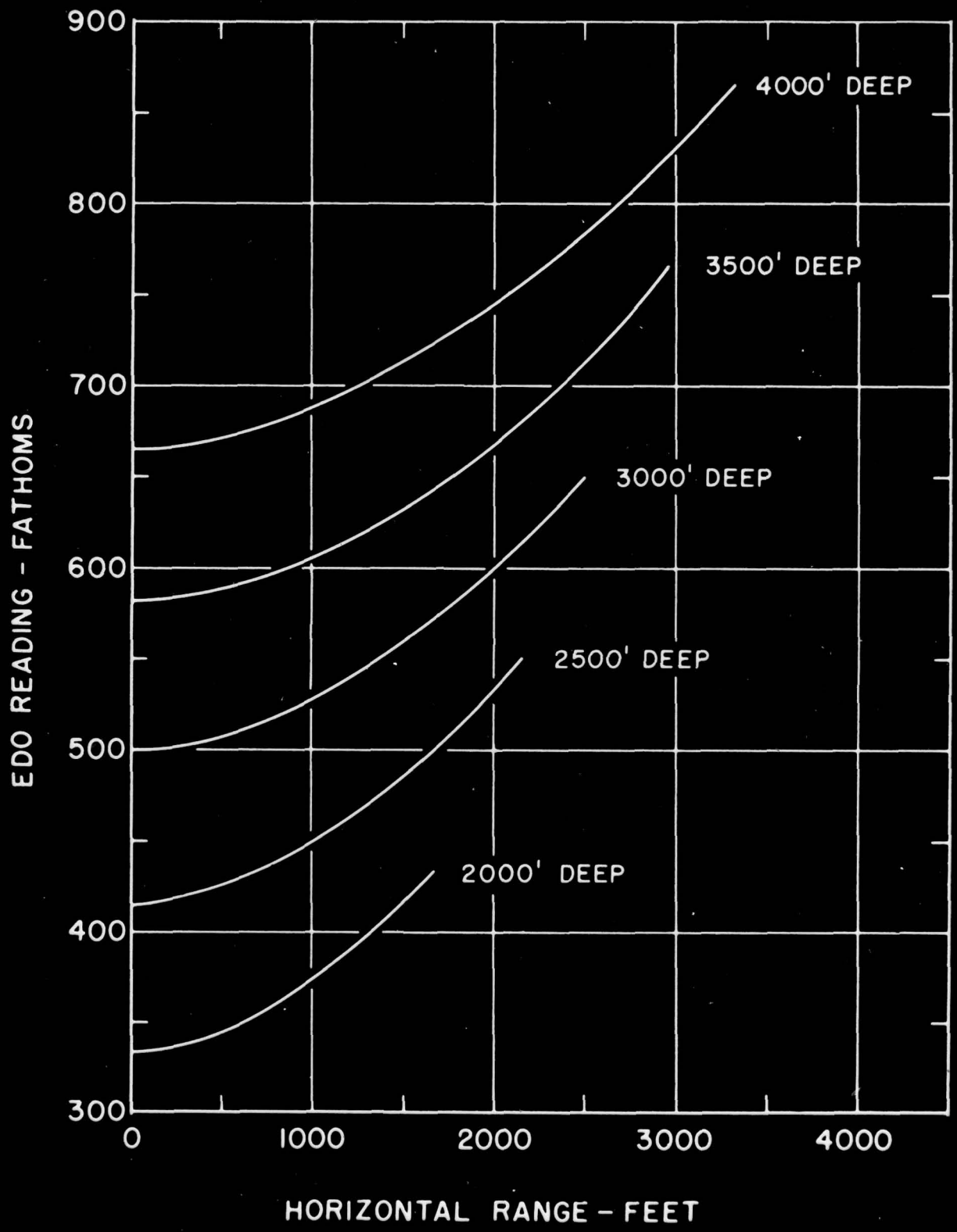

Fig. 3 Curves of horizontal range versus depth. Sounding velocity is 800 fms/sec.

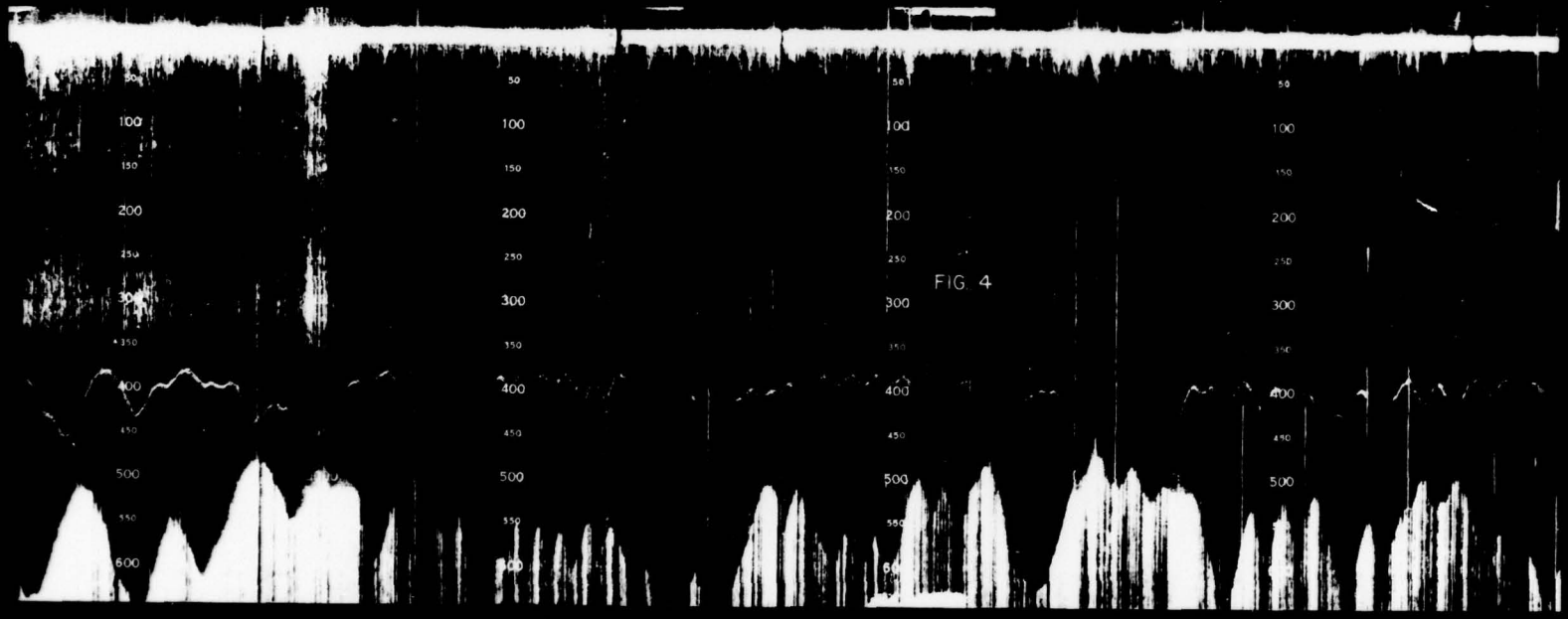

Fig. 4 Echo-sounding record showing APK and bottom echoes. Ship Horace Lamb was circling APK and maintaining contact on the basis of this record.